

Naval Facilities Engineering Command Southwest
BRAC PMO West
San Diego, CA

DRAFT
PARCEL G REMOVAL SITE EVALUATION WORK
PLAN ADDENDUM

Radiological Investigation, Survey, and Reporting
Parcel G

FORMER HUNTERS POINT NAVAL SHIPYARD
SAN FRANCISCO, CALIFORNIA

April 2019

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Prepared for:



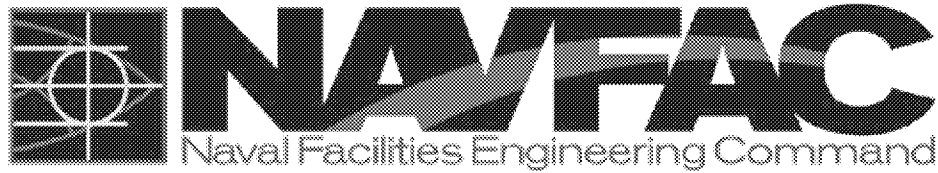
Department of the Navy
Naval Facilities Engineering Command Southwest
BRAC PMO West
33000 Nixie Way, Bldg. 50
San Diego, CA 92147

Prepared by:



Aptim Federal Services, LLC
4005 Port Chicago Highway, Suite 200
Concord, CA 94520

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Lisa Bercik, PE
Project Manager

Date

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Acronyms and Abbreviations

^{137}Cs	cesium-137
^{226}Ra	radium-226
$\mu\text{R/hr}$	microrentgen per hour
ALARA	as low as reasonably achievable
APP/SSHP	<i>Accident Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California</i>
APTIM	Aptim Federal Services, LLC
cm	centimeter
cpm	counts per minute
g/cm^3	gram per cubic cm
HPNS	Former Hunters Point Naval Shipyard
keV	kiloelectron volts
MARSSIM	<i>Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)</i>
MDC	minimum detectable count
MDCR	minimum detectable count rate
NaI	sodium iodide
Navy	U. S. Department of the Navy
NRC	U.S. Nuclear Regulatory Commission
RPP	<i>Radiological Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California.</i>
SAP	Sampling and Analysis Plan
WP	<i>Parcel G Removal Site Evaluation Work Plan, Former Hunters Point Naval Shipyard, San Francisco, California</i>
WPA	work plan addendum

1.0 INTRODUCTION

Aptim Federal Services, LLC (APTIM) will implement soil investigation removal activities at Parcel G, Former Hunters Point Naval Shipyard (HPNS), San Francisco, California as described in Section 3.0 of the *Final Parcel G Removal Site Evaluation Work Plan, Former Hunters Point Naval Shipyard, San Francisco, California* (WP; CH2M Hill, Inc., 2019). This Removal Site Evaluation Work Plan Addendum (WPA) supplements the information provided in the WP (CH2M Hill, Inc., 2019) and includes APTIM-specific personnel, radiological instrument information, and supporting documents.

The Parcel G investigation is being performed for the U.S. Department of the Navy (Navy), Naval Facilities Engineering Command Southwest, under Contract No. N62473-17-D-0006, Contract Task Order N6247318F5065. Base Realignment and Closure Program Management Office West will manage the work elements under this Contract Task Order.

1.1 Scope of Work

The scope of the planned activities consists of the following elements:

- Develop the WPA and associated appendices
- Implement soil-investigation-removal activities, as described in Section 3.0 of the WP (CH2M Hill, Inc., 2019)
- Prepare the remedial action completion report

The primary scope components include investigating the SS/SD excavation areas, former building sites, and Building 351A crawl space.

1.2 Project Schedule

Table 1 provides the project schedule for the Parcel G soil-investigation-removal activities.

1.3 Project Organization

Table 2 provide key personnel.

1.4 Site Safety

Field activities will be conducted in accordance with the project *Accident Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California* (APP/SSHP; APTIM, 2019a). Applicable federal and California Occupational Safety and Health Administration regulations and permit requirements will be followed, as well as the *Safety and Health Requirements Manual, EM 385-1-1* (U.S. Army Corps of Engineers, 2014) and *Unified Facilities Guide*

Specifications, Section 01 35 26, Governmental Safety Requirements (Naval Facilities Engineering Command, 2015).

1.5 Radiation Protection Program

The *Radiological Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California*. (RPP; APTIM, 2019b) defines the requirements for radiological protection support work performed by APTIM at HPNS. An overview of the performance of radiological hazard analysis and controls; analysis of smears, internal and external dosimetry; and other matters regarding radiation protection is presented in the RPP. For radiological activities, APTIM will invoke Nuclear Regulatory Commission License 20-31340-01 and California State Radiological License 7889-07 to perform this work at HPNS. APTIM will also establish areas of control under a Memorandum of Understanding with the HPNS low-level radioactive waste brokering company and other Navy contractors as required. The intent of the Memorandum of Understanding is to outline the general applicability and responsibilities of each entity as applicable to corresponding work scope and license compliance parameters.

APTIM's policy is that radiological work, including work with radioactive materials or ionizing radiation, be purposeful and performed in a manner that protects workers, members of the general public, and the environment. Exposures to ionizing radiation and releases of radioactive material will be managed to reduce individual and collective doses to workers and the public and ensure that exposure is as low as reasonably achievable (ALARA). Work involving radiological hazards may not begin unless that work can be performed in a safe manner, compliant with rules and regulations. Moreover, APTIM endorses and applies ALARA principles. The ALARA principle is integrated in activities described in this WPA and will be implemented during the course of the work carried out under this WPA.

Project participants with the intent to enter a posted restricted area must successfully complete site-specific radiation worker training. The participants must also be briefed on the RPP (APTIM, 2019b) and sign acknowledgement that the participant has read and understands the requirements.

Employees working at the site have authorization to stop work if an unsafe condition exists or a safety procedure is being disregarded in accordance with *APTIM Management System*, AMS-710-05-PR-00400, "Stop Work Authority" (APTIM, 2019c).

1.6 Removal Site Evaluation Work Plan Addendum Organization

This WPA consists of three sections and supplements the information provided in the WP (CH2M Hill, Inc., 2019). The WP (CH2M Hill, Inc., 2019) provides the conceptual site model, soil investigation design and implementation, data evaluation and reporting, radioactive materials management and control, Waste Management Plan, and Environmental Protection Plan. This WPA is organized as follows:

- Section 1.0, “Introduction”—Section 1.0 provides an introduction, project organization, site safety, radiation protection program, and the WPA organization.
- Section 2.0, “Project Requirements”—Section 2.0 describes the required supporting project documents.
- Section 3.0, “Radiological Survey Instrumentation”—Section 3.0 includes operating specifications for the radiological survey instruments to be used during this investigation.
- Section 4.0, “References”—Section 4.0 includes a list of documents used to compile this WPA.
- Appendices A through F—Responses to Comments, Sampling and Analysis Plan (SAP) Addendum, Contractor Quality Control Plan, Stormwater Management Plan, Dust Management Plan, ISO-PACIFIC Soil Sorting Operations Work Plan, and the Gamma Scan Minimum Detectable Concentrations are included as Appendices A, B, C, D, E, F and G, respectively.

2.0 PROJECT REQUIREMENTS

This section discusses required project plans.

2.1 Accident Prevention Plan/Site Safety and Health Plan

The APP/SSHP (APTIM, 2019a) was prepared to support fieldwork in accordance with *Safety and Health Requirements Manual, EM 385-1-1* (U.S. Army Corps of Engineers, 2014) and *Unified Facilities Guide Specifications, Section 01 35 26, Governmental Safety Requirements* (Naval Facilities Engineering Command, 2015). The APP/SSHP is a standalone document, submitted under a separate cover.

2.2 Radiation Protection Plan

The RPP (APTIM, 2019b) was prepared to support work performed by APTIM at Parcel G. It is a standalone document and was submitted under a separate cover. The RPP document requirements and standard operating procedures to ensure qualified personnel, proper radiological controls, and approved standard operating procedures (APTIM, 2019b) are used to perform radiological work at the site

2.3 Sampling and Analysis Plan

A SAP was prepared and included as Appendix B to the WP (CH2M Hill, Inc., 2019). APTIM prepared a SAP addendum to include personnel and laboratory-specific information for this work (Appendix B).

2.4 Contractor Quality Control Plan

APTIM prepared a Contractor Quality Control Plan (Appendix C). The Contractor Quality Control Plan was prepared in accordance with *Unified Facilities Guide Specifications, Section 01 35 26, Governmental Safety Requirements* (Naval Facilities Engineering Command, 2015).

2.5 Environmental Protection Plan

An Environmental Protection Plan was prepared and included as Section 8 of the WP (CH2M Hill, Inc., 2019).

2.5.1 Stormwater Management Plan

APTIM prepared a Stormwater Management Plan (Appendix D).

2.5.2 Dust Management Plan

APTIM prepared a Dust Management Plan (Appendix E).

2.6 Waste Management Plan

A Waste Management Plan was prepared and included in Section 7 of the WP (CH2M Hill, Inc., 2019).

2.7 Soil Sorting Plan

The ISO-PACIFIC Soil Sorting Operations Works Plan was prepared to support work performed at Parcel G. It is a standalone document and is included as Appendix F.

3.0 RADIOLOGICAL SURVEY INSTRUMENTATION

This section describes operating specifications for radiological survey instrumentation to be used during the Parcel G soil investigation.

3.1 Soil Gamma Instruments

The gamma scanning survey instruments will be selected to provide a high degree of defensibility and based on their capability to measure and quantify gamma radiation and position using the best available technology. The primary gamma scanning instrument that will be used during trench unit surface scan surveys, soil scan surveys of excavated trench soil (either following the radiological screening yard or soil sorting processes), and soil area survey units (former Buildings 317/364/365 and Building 351A crawlspace) will consist of sodium iodide (NaI) or plastic scintillation detectors equipped with automated data logging. With the exception of the 3-inch-by-3-inch NaI detector, the gamma scan survey system will be equipped with gamma spectroscopy capabilities, providing the benefit of collecting spectral measurements in addition to the gross gamma measurements. The spectra will be evaluated using region of interest-peak identification tools for the radionuclides of concern that correspond to gamma rays at 186 kiloelectron volts (keV) for radium-226 (^{226}Ra), 609 keV for ^{226}Ra daughter bismuth-214, 662 keV for cesium-137 (^{137}Cs), and a gross gamma window (i.e., full energy spectrum). Details on the evaluation of regions of interest and gross gamma windows for the RS-700 system are provided in Section 3.5.1.1 of the WP (CH2M Hill, Inc., 2019).

The gamma scanning instrument will be equipped with a positioning sensor and software that is able to simultaneously log continuous radiation and position data. The gamma radiation measurement will be coupled to the position measurement to allow for precise visualization of the data set, for both RS-700 gamma walkover data and the 3-inch-by-3-inch NaI gamma walkover data. For gamma scan surveys of retrieved cores, a 3-inch-by-3-inch NaI detector will be used. Table 3 lists the instruments that are expected to be used during fieldwork.

Because the Building 351A crawl space survey is under the building, it is not possible to electronically log global positioning system data during the survey. Lanes of approximately 1 meter in width will be marked out within each survey unit. The technician(s) performing the survey will make a note of what corner of the building the survey will start from (northeast, southwest, etc.), and the direction of travel within each lane. During the survey, the technician will record the observed count rate approximately once every meter while surveying within the designated lane. Survey lanes shall be identified by the use of survey pin flags, cones, or other similar markers.

The RS-700 system is composed of two 4-liter NaI detectors. The detectors are mounted end-to-end lengthwise with a gap of approximately 4 inches between the detectors. The detectors are maintained at a constant distance above the ground of approximately 15.24 centimeters (cm), with each pass offset by approximately 112 cm from the previous pass to ensure complete gamma scan coverage.

The a priori scan minimum detectable counts (MDCs) for the 3-inch-by-3-inch NaI detector and the RS-700 system are calculated in the same manner as Section 3.5.2.2 of the WP (CH2M Hill, Inc., 2019). Appendix G presents the Microshield modeling and calculations for the scan MDCs for ^{137}Cs and ^{226}Ra . Appendix F includes information for the MDCs of the soil sorting system. Table 4 shows a priori scan MDCs.

3.2 Survey Investigation Levels

The same survey methods and equipment that will be used for conducting a survey in an impacted area will be used for the background area data collection. Reference background data and investigation levels will be provided to the radiological control technicians prior to the start of a survey for their use during data collection. Gamma scanning and static measurements collected from the reference area will be used to develop instrument-specific investigation levels for gamma walkover survey and gamma static measurements. Each investigation level is based on the instrument-specific mean background value plus 3 standard deviations of the mean. Scan and static data will also be collected with the RS-700 system to establish background data for the spectral analysis process.

3.3 Instrument Detection Calculations

The equations to calculate efficiencies, MDCs, and minimum detectable count rates (MDCRs) at HPNS are based on the methodology and approach used in *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)* (MARSSIM, U.S. Nuclear Regulatory Commission [NRC] et al., 2000) (Chapter 6) and U.S. Nuclear Regulatory Commission (NRC) Regulation (NUREG)-1507 (Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions [NRC, 1998]) (Chapter 6). The instrument equations in this section may be used to calculate adjustments if a Certified Health Physicist approves changes in writing before initial use. The following subsections present calculation examples intended to illustrate the calculation approach.

3.3.1 Gamma Surface Activity

Estimating the amount of radioactivity that can be confidently detected using field instruments is performed by adapting the methodology and approach used in MARSSIM (Section 6.7.2.1) and NUREG-1507 (NRC, 1998) (Section 6.8.2) for determining the gamma scan MDC for photon-emitting radionuclides.

The scan MDC (in picocurie per gram) for areas is based on the area of elevated activity, depth of contamination, and the radionuclide (energy and yield of gamma emissions). The computer code Microshield can be used to model expected exposure rates from the radioactive source at the detector probe NaI crystal and includes source-to-detector geometry. The geometry is used to calculate the total flow of photons incident upon the detector crystal, called the gamma fluence rate, ultimately corresponding to an exposure rate that is associated with a count rate in the instrument.

The amount of radiation the detector crystal is exposed to from the modeled source is used to determine the relationship between the detector's net count rate and the net exposure rate (counts per minute [cpm] per microrentgen per hour [$\mu\text{R/hr}$]).

3.3.2 Gamma Scan Minimum Detectable Concentration

The general assumptions and modeling inputs are as follows:

- Ambient background count rate of 18,000 cpm, based on the general observed average count rate from a Treasure Island reference area.
- Average background count rate of 3,767 counts per second (the per-detector average) for the RS-700, equal to 226,018 cpm, based on the observed average count rate for the RS-700 from a Treasure Island reference area.
- Count rate to exposure rate ratio of 2,300 cpm per $\mu\text{R/hr}$ for ^{137}Cs (manufacturer's reported ratio for Ludlum Model 44-20 3x3 NaI detector).
- Estimated count rate to exposure rate ratio of 42,483 cpm per $\mu\text{R/hr}$ for ^{137}Cs (based on observation of 226,018 cpm in a 5.32 $\mu\text{R/hr}$ field) for the RS-700.
- Length of the 3x3 NaI parallel to the surveyed surface is equal to 3 inches (7.6 cm).
- Length of the detector parallel to the surveyed surface is equal to 4 inches (10.16 cm).
- For scans using the 3x3, level of performance (d') is equal to 1.38, corresponding to 95 percent true positive detection rate and 60 percent false positive detection rate--for the 3x3 NaI a higher false positive detection rate is acceptable as the technician performing the scanning surveys will have the flexibility to investigate audible or visible changes in count rate (i.e., conduct "second stage scanning", per MARSSIM).
- For scans using the RS-700, level of performance (d') is equal to 3.28, corresponding to 95 percent true positive detection rate and 5 percent false positive detection rate - for the RS-700 a lower false positive detection rate is desired as the size and mobility of the system will limit the technician's ability to investigate anomalous measurements in real time.
- The thickness of the aluminum housing for the 3x3 is 0.02 inches (0.051 cm), with a density of 2.7 grams per cubic cm (g/cm^3).
- The thickness of the carbon fiber and foam casing of the RS-700 detector is modeled as a 0.125 inch (0.318 cm) carbon layer with a density of 2.27 g/cm^3 . The aluminum covering for the NaI crystal is 0.02 inches (0.051 cm), with a density of 2.7 g/cm^3 .
- Scan speed for the 3x3 is 0.5 meters per second, resulting in an observation interval of one second

- The scan speed for the RS-700 is 0.25 meters per second, resulting in an observation interval of two seconds
- Surveyor efficiency of 0.50 for the 3x3
- Surveyor efficiency of 0.9, increased from a default of 0.5 based on the constant surveyor speed, data logging, mapping, and spectral analysis features of the RS-700 system.

The following equations are used in the calculation of gamma scan MDCs (detailed calculations are found in Appendix G for both detectors and radionuclides of concern):

Calculation of MDCR and $MDCR_{Surveyor}$

$$s_i = d' \sqrt{b_i}$$

$$MDCR = s_i \times (60/i)$$

$$MDCR_{Surveyor} = \frac{MDCR}{\sqrt{p}}$$

Where:

d'	measurement performance parameter, determined from desired true positive and false positive rates from MARSSIM Table 6.5, unitless, equal to 1.38
b_i	number of background counts observed during observation interval i , in counts
s_i	number of source counts required for a specified level of measurement performance and observation interval i , in counts:
$MDCR$	minimum detectable count rate, in cpm
$MDCR_{Surveyor}$	minimum detectable count rate accounting for surveyor efficiency, in cpm
p	surveyor efficiency, equal to 0.5

Calculation of the Fluence Rate to Exposer Rate

$$Fluence\ Rate\ to\ Exposure\ Rate \approx \frac{\left(1 \frac{\mu R}{hr}\right)}{E_r \left(\frac{\mu_{en}}{\rho}\right)_{air}}$$

Calculation of Probability of Interaction Through the Detector

$$Probability\ of\ Interaction\ (P) = 1 - e^{-\left(\left(\frac{\mu}{\rho}\right)_{NaI} (x)(\rho NaI) d\right)}$$

Where

x	Length of detector parallel to surveyed surface, equal to 7.6 cm
ρ_{NaI}	Density of NaI, equal to 3.67 g/cm ³

Calculation of Relative Detector Response

$$RDR = FRER \times P$$

Calculation of the Total Energy-Weighted cpm/μR/hr Ratio

$$weighted(cpm/\mu R/hr) = \sum \left(\frac{\dot{X}_{E_i}}{\dot{X}_{Total}} \times \frac{cpm}{\mu R/hr}, E_i \right)$$

Calculation of the Exposure Rate at the MDCR_{Surveyor} and Scan MDC

$$\dot{X}, MDCR_{Surveyor} = \frac{MDCR_{Surveyor}}{weighted(cpm/\mu R/hr)}$$

$$Scan\ MDC\left(\frac{pCi}{g}\right) = Modeled\ Conc. \times \frac{\dot{X}, MDCR_{Surveyor}}{\dot{X}_{Total}}$$

Table 4 presents a summary of the gamma scan MDCs for ²²⁶Ra and ¹³⁷Cs.

3.4 Calibration

Survey instrument calibration is completed annually, or every two years for the RS-700. Instrument calibration is also performed after repairs or modifications have been made to the instrument. The instruments will be calibrated in accordance with the manufacturer's recommended method.

3.5 Daily Performance Checks

Prior to use of the radiological survey instruments, calibration verification, physical inspection, battery check, and a source response QC check are performed daily in accordance with AMS-710-07-PR-04013, "Radiation Detection Instrumentation" (APTIM, 2019c), AMS-710-07-WI-40141, "Operation and Use of Portable Instruments" (APTIM, 2019c), and other applicable procedures. Physical inspection of the portable survey instrument will include the following:

- General physical condition of the instrument and detector before each use
- Knobs, buttons, cables, connectors
- Meter movements and displays
- Instrument cases

- Probe and probe windows
- Other physical properties that may affect the proper operation of the instrument or detector

Any portable survey instrument or detector having a questionable physical condition will not be used until problems have been corrected. A battery check will be performed to ensure that sufficient voltage is being supplied to the detector and instrument circuitry for proper operation. This check will be performed in accordance with the instrument's operations manual. The instrument will be exposed to the appropriate (alpha, beta, gamma) check source to verify that the instrument response is within the plus or minus 20 percent range determined during the initial response check. The calibration certificates and daily quality assurance/quality control records for each instrument used and the instrument setup test records will be provided in the project report.

If any portable survey instrument, or instrument and detector combination, having a questionable physical condition that cannot be corrected fails any of the operation checks, or has exceeded its annual calibration date without Project Radiation Safety Officer approval, the instrument will be put in an "out of service" condition. This is done by placing an "out of service" tag or equivalent on the instrument and securing the instrument or the instrument and detector combination in a separate area such that the instrument and instrument and detector combination cannot be issued for use. The Project Radiation Safety Officer and Radiological Control Technician and their respective supervisors will be notified immediately when any survey instrumentation has been placed "out of service." Instruments tagged as "out of service" will not be returned to service until all deficiencies have been corrected. The results of the daily operation checks, previously discussed, will be documented.

4.0 REFERENCES

Aptim Federal Services LLC (APTIM), 2019a, *Accident Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California.*

APTIM, 2019b, *Radiological Prevention Plan, Radiological Investigation, Survey, and Reporting, Parcel G, Former Hunters Point Naval Shipyard, San Francisco, California.*

APTIM, 2019c, *APTIM Management System.*

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U.S. Nuclear Regulatory Commission, 1998, *Minimum Detectable Concentrations with Typical Radiation Survey Instruments for Various Contaminants and Field Conditions. NUREG/CR-1507. Washington, D.C.*

U.S. Nuclear Regulatory Commission, U.S. Environmental Protection Agency, and U.S. Department of Energy, 2000, *Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), NUREG-1575, EPA 402-R-97-016, DOE/EH-0624, Revision 1, Washington, D.C.*